CLAIMS

1. [currently amended] An internal combustion (IC) engine for igniting, combusting, and expanding a burnt air-fuel mixture and producing work by means of a movable piston within a cylinder that has a cylinder head with intake and exhaust valve openings with the combustion chamber located mainly in the head, and further including squish lands for producing high squish-flow and turbulence as the piston nears top center (TC) at the engine compression stroke, the system constructed and arranged to have ~~one~~ two or more spark plugs positioned and oriented such that as the piston approaches top center, intense air flow passes through the spark gap to move and spread the spark towards the center of the combustion chamber,

the improvement comprising control means for improving the lean burn capability of the engine under light load conditions and the knock rating under high loads ~~by one or more of the following:~~ wherein the said at least two spark plugs have flexibility relative to each other in terms of ignition firing the said and timing such that the two spark plugs at or near the edge of a high squish region are controlled such that at light loads both plugs are fired, and at selected high load condition the plugs are fired independently, including situations wherein only one plug is fired at a high load where the burn may be too fast with two plugs and cause engine harshness or knocking, so that by firing one spark plug instead of two the harshness may be reduced.

2. [previously amended] An IC engine system as defined in claim 1 including two spark plugs located at or near high squish regions in the combustion chamber which is of a bathtub shape with large squish lands on the two sides of the length section of the bathtub, and a small squish zone at the far end of the bathtub containing the intake valve opening, and a smaller or no squish zone at the far end of the bathtub containing the exhaust valve opening.

3. [previously amended] An IC engine system as defined in claim 2 wherein one spark plug is located in a more central part of the squish edge at a high squish point and the other at a lower squish point nearer to the exhaust valve opening.

4. [previously amended] An IC engine system as defined in claim 1 wherein two spark plugs are used and wherein the two plugs have different spark gap widths.

5. [previously amended] An IC engine system as defined in claim 4 wherein the plug nearer the exhaust valve opening has the smaller spark gap and is fired by itself at high loads, versus both being fired at light load.

6. [original claim] An IC engine system as defined in claim 1 wherein the fuel introduction means is essentially centrally located fuel injection means.

7. [original claim] An IC engine system as defined in claim 1 wherein one or more essentially radially outwards fuel injection sprays collide with squish land induced radially inwards squish flow.

8. [original claim] An IC engine system as defined in claim 7 wherein at least one of one or more spark plugs are located at the edge of the squish zone with which the fuel injection spray interacts.

9. [previously amended]. An internal combustion (IC) engine for igniting, combusting, and expanding a burnt air-fuel mixture and producing work by means of a movable piston within a cylinder that has a cylinder head with the combustion chamber located mainly in the head, and further including squish lands for producing high squish-flow and turbulence as the piston nears top center (TC) at the engine compression stroke, the system constructed and arranged to have one or more spark plugs, each with a spark gap, positioned and oriented such that as the piston approaches top center, intense air flow passes through one or more of the spark gaps to move and spread the spark towards the center of the combustion chamber,

the improvement comprising means for improving the lean burn capability of the engine under light load conditions and the knock rating under high loads, by direct fuel injection means including air-blast means surrounding the fuel spray.

10. [original claim] An IC engine system as defined in claim 9 wherein spark gap ignition means is also contained in the air-blast fuel injection means.

11. [original claim] An IC engine system as defined in claim 10 wherein the air blast entry in above the fuel entry means which is in turn above the spark gap means, defining a three-part system.

12. [original claim] An IC engine system as defined in claim 11 wherein said three-part system is essentially circularly symmetric.

13. [original claim] An IC engine system as defined in claim 10 wherein said three-part system is located in the center of the cylinder head of a four valve engine.

14. [original claim] An IC engine system as defined in claim 1 wherein variable compression ratio means are provided, with high compression ratio at light loads and lower compression ratio at high loads.

15. [original claim] An IC engine system as defined in claim 14 wherein variable compression means is achieved by having piston top, at the high compression condition, approach as close as practical to the cylinder head without hitting it, defining a very small squish clearance and very high flow, and having the piston further away at low compression ratio.

16. [original claim] An IC engine system as defined in claim 15 wherein the high compression ratio is approximately 15 to 1.

17. [currently amended] An IC engine system as defined in claim 14 wherein variable compression ratio is achieved by having an "H" annular groove within the piston held by the wrist-pin with annular springs in the top and bottom groove of the "H" groove.

18. [currently amended] An IC engine system as defined in claim 1 wherein variable compression ratio is provided and such variable compression ratio is achieved by having a two part connecting rod with spring means providing the variable compression ratio.

19. [currently amended] An IC engine system as defined in claim 18 wherein said spring means are two annular springs.

20. [currently amended] Method for igniting, combusting, and expanding a burnt air-fuel mixture in an internal combustion (IC) engine and producing work by means of a

movable piston within a cylinder that has a cylinder head with intake and exhaust valve openings with the combustion chamber located mainly in the head and fuel introduction and spark means in or adjacent to the combustion chamber, and further including means for producing high squish-flow and turbulence as the piston nears top center (TC) at the engine compression stroke, the system constructed and arranged to have two or more spark plugs positioned and oriented such that as the piston approaches top center, intense air flow passes through the spark gap to move and spread the spark towards the center of the combustion chamber,

the improvement comprising steps for improving the lean burn capability of the engine under light load conditions and the knock rating under high loads by using at least two plugs each ~~coil~~ and providing the two spark plugs with flexibility relative to each other in terms of ignition firing and timing such that the:

1) two spark plugs at or near the edge of a high squish region are controlled such that at light loads both plugs are fired, and at some high load conditions the plugs are fired independently, including one or more conditions in which only one plug is fired at very high load where the burn may be too fast with two plugs and cause engine harshness or knocking, so that by firing one spark plug instead of two the harshness may be reduce;

2) the spark gap sizes may differ so that spark gaps can be used to accommodate the different flow levels and cylinder pressures to prevent blow-out or non-sparking of the spark at very high flows and pressures.

21. [previously presented]An IC engine system as defined in claim 20 wherein the two spark plugs are in each cylinder and each spark plug has a coil associated with it, wherein the coils and plugs are fired independent of each other and wherein the coils are operated at higher than 12 volts battery voltage, i.e. about 42 volts.

22. [previously presented]An IC engine system as defined in claim 20 wherein said two spark plugs are fired to the piston and have a spark firing timing of 5° to 30° before top center (BTC), so that at light loads the spark may be advanced to approximately 30° and at high load may be retarded at approximately 5° which keeps the spark breakdown voltage between approximately 10 kV and 33 kV, depending on ignition timing and engine load.

23. [previously presented]An IC engine system as defined in claim 20 comprising means for removing squish from the far side of the exhaust valve to make room for a larger intake valve for better breathing but only a slight reduction of the two large squish lands and squish flow at the spark plug sites.

24. [new] The method of claim 20 and further providing two or more spark plugs wherein the spark gap sizes differ and controlling firing selectively so that spark gaps can be used to accommodate the different flow levels and cylinder pressures to prevent blow-out or non-sparking of the spark at very high flows and pressures.